Investment liberalisation, technology take-off and export market entry: Does foreign ownership structure matter?

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Abstract:
In the run up to its accession to the WTO in 2001, China has undergone far-reaching investment liberalisation. As part of this investment liberalisation process, existing restrictions on foreign ownership structure and mandatory export and technology transfer requirements imposed on foreign firms have been lifted in a number of industries. We exploit these facts to identify the causal effects of foreign acquisitions on export markets entry and technology take-off and to evaluate whether the level of foreign ownership plays a role in stimulating these changes. Using doubly robust propensity score reweighted bivariate probit regressions to control for the selection bias associated with firm level foreign acquisition incidences, we uncover strong but heterogeneous positive effects on export activity for all types of foreign ownership structure. We also find that minority foreign owned acquisition targets experience higher likelihood of R&D, providing evidence that joint ventures between foreign owners and Chinese firms can contribute positively to China's "science and technology take-off".

1. Introduction

There are a number of theoretical models that examine the host country welfare effects of foreign investment liberalisation (Markusen 2004; Egger et al., 2007; McGrattan and Prescott, 2009). This literature has significantly enhanced our understanding of the mechanisms through which investment liberalisation can enhance growth. Two key mechanisms are identified in this respect: technological development and trade expansion. McGrattan and Prescott (2009) provide a theoretical analysis that shows greater openness to FDI leads to substantial gains in the opening economy through the exploitation of investing countries' technology capital. Markusen (2004) predicts significant trade effects of foreign investment liberalisation, these effects being positive or negative depending on whether FDI is vertical or horizontal. [1]

This paper contributes to this line of inquiry by evaluating the impact of foreign investment liberalisation on the probability that a firm enters exports markets for the first time, and the likelihood that a firm experiences technology take-off, which we define as engaging in R&D activity for the first time. We are mainly interested in analysing whether the degree of foreign ownership attracted by the firm plays a role in facilitating these processes. This is done by using a comprehensive firm level database covering enterprises in the Chinese manufacturing sector which allows us to identify the sub-population of firms with no exports, R&D and FDI before China joined the WTO in 2001. Some of these firms are subsequently partly or wholly acquired by foreign MNEs courtesy of investment liberalisation entailed by WTO entry, and we are able to trace the exporting and R&D transitions of individual firms between the pre- and post-liberalisation periods.

[1] Amiti and Wakelin (2003) take this prediction to bilateral FDI and export data, and conclude that investment liberalization stimulates exports when countries differ in relative skill endowments provided trade costs are not too high.

Our empirical strategy exploits major changes in FDI policy following investment liberalisation in China. Firstly, the fact that restrictions on foreign ownership structure have been lifted in a number of industries allows us to investigate the role of ownership structure on the FDI-export/R&D nexus. Secondly, the removal of mandatory export and technology transfer requirements imposed on foreign firms affords us the opportunity to identify more precisely the causal effects of foreign acquisitions on export markets entry and technology take-off.

China is an interesting case study to evaluate these effects as it is well-documented that exports promotion and technology transfer are the two most important FDI policy objectives in China (Long, 2005). Macroeconomic figures would appear to suggest that the investment liberalisation process undergone by China in the run up to its accession to the WTO in 2001 has met with success. By 2010, about 14 percent of global foreign direct investment flows went into the Chinese economy. China also accounted for roughly 10 percent of world-wide exports in 2010, making it the world's top exporter in that year (WTO, World Trade Report 2011). Over the same time, China has begun what Jefferson and Gao (2007) term its "science and technology (S&T) take-off". Data available from the World Development Indicators also show that, between 1996 and 2007, China increased its R&D expenditures from 0.5 to 1.4 present of GDP – making it comparable to many industrialized countries. Investigating the causal effects of foreign ownership structure on export entry and technology take-off during this investment liberalization period is therefore not only of academic merit but also highly policy relevant.

In order to evaluate the causal effects of foreign acquisitions on R&D and exporting, we implement a propensity score reweighting estimator (Hirano et al., 2003) combined with covariate adjustment, the so-called doubly-robust estimator (Bang and Robins, 2005). A major advantage of the doubly robust estimator is that it provides correct identification even if either the propensity score or the conditional mean regression models are misspecified. The use of propensity score based methods - in most cases propensity score matching- to infer the causal effects of foreign

acquisitions is not new to the applied international economics literature [e.g. Girma and Görg (2007), and Arnold and Javorcik (2009)]. But to our knowledge this is the first paper that combines propensity score weighing with covariate adjusted regressions, and thus exploits the opportunity this offer to obtain robust inference even under possible model misspecification.

Besides identifying causal relationships using an empirical method most appropriate to the demands of the data, this paper addresses a number of important issues that have either been underexplored or unexplored in the existing literature. Firstly we investigate the R&D and export decisions jointly. Thus far, the literature on the effects of foreign acquisitions has tended to concentrate on either technology or exporting.[2] However, as Bustos (2011) and Hanley and Monreal-Perez (2012) show theoretically and empirically, technology upgrading (through investments in R&D or skills) and exports are likely to be related. Firms may either upgrade technology pre-export entry to improve quality or post-export entry through learning effects.

Secondly, we look specifically at whether the degree of foreign ownership (or ownership structure) matters for technology upgrading and exports. This has, to the best of our knowledge, not received much attention in the literature. An exception is Thomas et al. (2008), who provide a descriptive analysis showing that foreign owners forming contractual agreements with local partners through joint ventures, equity joint ventures and joint stock enterprises are more successful in inducing new product developments than wholly owned firms. However, in their empirical approach they cannot claim to establish causal relationships. Another related paper is Guadalupe et al. (2012), who investigate the link between foreign acquisition and innovation activity using firm level data for Spain. They also use a propensity score reweighting estimator, though not a doubly-robust estimator. Also, in contrast to our paper, they do not investigate whether ownership structure matters.

[2] For example, a number of papers employing propensity score matching show that foreign acquisitions lead to productivity increases (Arnold and Javorcik, 2009), where the implicit assumption is that technology improvements drive these increases in productivity. A number of studies also look at the relationship between acquisitions and exporting, see, for example, Du and Girma (2009) using firm level data for China.

Thirdly, a distinctive feature of our paper is the focus on new export market entrants and first time R&D investors. Prior exporting and R&D experience or lack thereof could be a sign of some unobserved firm level heterogeneity, and it can be empirically difficult to disentangle state-dependence from acquisition effects. Thus focusing on changes in exporting and R&D status provides a cleaner identification strategy.

The remainder of the paper is structured as follows. Section 2 discusses investment liberalisation episodes in China, and how these inform our study. Section 3 describes the firm level data we use and presents some descriptive statistics. Section 4 outlines the empirical methodology used. Section 5 discusses our main findings, and reports results from a number sensitivity and robustness analyses. Some concluding comments are presented in Section 6.

2. Institutional background

We provide a brief description of the salient features of foreign investment liberalisation in China in order to show that China provides a very suitable test case to investigate the relationship between FDI, export entry and technology take-off. This will also help demonstrate how changes in FDI legislations resulting from investment liberalisation have informed the design of our econometric analysis.

Prior to its accession to the WTO in 2001, China's FDI policy was rather restrictive involving a cumbersome examination and approval system through which the government exerted control over the entry of foreign firms (Chen, 2011; Qin, 2007). Depending on the industries they operate in, FDI projects were classified into categories of encouraged, permitted, restricted and prohibited. The restrictions imposed on foreign firms ranged from performance requirements to foreign equity share limits. However, as Qin (2007) reports, following the investment liberalisation the number of encouraged industries has increased from 186 to 262, while restricted industries decreased from 112 to 75.

More relevant to this study, and as discussed by Chen (2011) and Long (2005), the major changes in legislation on foreign investment in non-prohibited industries are (i) FDI may take the form of wholly foreign-owned enterprises or equity joint ventures with no restriction placed on foreign partners being the minority or majority shareholders (including the stipulation that foreign parties are required to contribute at least 25 percent of total capital); (ii) Mandatory export requirements imposed on wholly owned foreign firms (they were required to export at least 70 per cent of their production) and joint ventures has been removed; (iii) The requirement for wholly-owned foreign firms to engage in technology transfer and establish R&D centres is also no longer in place.

Commented [SL1]: Yundan, as Holger suggested, it would be nice to have a table with prohibited non-prohibited industries and trace the regulatory changes in these industries. Then, in the data description, we can show some descriptive statistics of these industries in our dataset (i.e. the evolution of the distribution of firms by ownership status, exporters and R&D). Do you think we can get this information easily?

A noticeable effect of the exogenous (from the firms' point of view) policy shift towards greater investment liberalisation is that wholly owned FDI enterprises have become the most popular form of FDI in China (Long, 2005). This indeed motivates our concern whether ownership structure mediates the FDI-export/R&D relationship. How should ownership structure affect technology upgrading and exports? There are two plausible arguments. Firstly, one may expect that a higher foreign ownership share should lead to higher levels of investment in technology and skills. There is case study evidence by Mansfield and Romeo (1980) that multinational parent firms transfer more up-to-date technology to wholly-owned affiliates than to joint ventures. Also, econometric studies by Asiedu and Efahani (2001) and Javorcik and Saggi (2010) show that multinationals with the highest level of technology enter host countries via wholly owned affiliates rather than joint ventures. This higher use of technology may arguably translate into technology upgrading and higher export activity in the foreign acquisition targets.

Secondly, however, one may also make a case that higher foreign ownership may be associated with lower technology and skill upgrading, if one assumes that there are different levels of technology gaps between purchaser and target depending on the level of foreign-ownership. If foreign owned firms tend to cherry pick the "best" targets for wholly-owned takeovers, then there may be only little need for technology upgrading as these firms are already operating close to the

technology frontier. However, for partially-owned firms, which are initially operating using lower levels of technology, there would be a higher technology gap vis-a-vis the target and the purchaser, hence, a higher level of technology and skill upgrading would be possible after the acquisition. Another, less benevolent view, may be that foreign owners are more likely to integrate wholly-owned affiliates completely into their international production network, stripping the affiliate of its R&D activities and relocating it to the headquarters. This may be less likely if the Chinese partner is involved. The theoretical expectation is, therefore, ambiguous and needs to be decided by empirical evidence.

It is precisely because hitherto existing restrictions on foreign ownership structure and mandatory export and technology transfer requirements imposed on foreign firms had been lifted as part of the investment liberalisation process, that we are better positioned to identify the causal effects of different forms of foreign acquisitions on export markets entry and technology take-off.

3. Description of the dataset

Our empirical analysis draws on a comprehensive firm level dataset, the Annual Reports of Industrial Enterprise Statistics, compiled by the China National Bureau of Statistics. The dataset covers all firms in China with an annual turnover of more than 5 million Yuan (about $785,000). These companies account for an estimated 85–90 percent of total output in most industries. The dataset includes information on the fraction of paid-in capital by foreign investors, R&D expenditure, employee training expenditure, export value, gross output, value added, wages, employment, ownership structure, industry affiliation, and geographic location, amongst other variables. The data used in the analysis cover the period 2001 (China's WTO entry year) to 2007 (just before the onset of the global financial crisis) and comprises more than 1.3 million observations from about 446,000 firms.

However, in view of the objective of this paper which is to identify the technology take-off and export market entry effects of foreign acquisition following investment liberalization, our econometric analysis is confined to firms which had no prior exporting and R&D in 2001. Of those, we then define a "treatment group" as those firms that attracted foreign capital for the first time between 2002 and 2006. Those firms that remained in domestic hands during the observation period are our "control group", again provided that they had no exporting and R&D activity prior to 2002. We also impose the condition that a firm has to be observed for at least three consecutive years in the sample. This leads us to an unbalanced panel of 27,513 firms spanning the period 2001-2007. This panel data allow us to control for pre-acquisition characteristics and evaluate the post-treatment effects on the year of acquisition and two periods following acquisition.

We define a foreign acquisition in time *t* as a firm that has a zero foreign ownership share in *t-1*, and a positive share in *t*. Acquisitions with "high" foreign ownership shares may have different implications that those with "low" foreign involvement. Rather than distinguishing two categories of shared and full ownership, as e.g., in Javorcik and Spatareanu (2008), we consider four foreign ownership categories based on the share of capital paid in by the foreign investors. These allow us a finer distinction, by providing for possible differences between minority and majority foreign ownership categories.

The first category comprises those acquired firms with a share of foreign capital lower than 25 per cent (which we refer as small minority foreign acquired firms). This takes account of specificity in China, namely, that these are defined by the Chinese authorities as local firms, but with some level of foreign capital. The second category includes firms with a foreign share higher than or equal to 25 per cent but lower than 50 per cent, which are considered foreign firms with minority foreign ownership. Our third category contains firms with a foreign share higher than or equal to 50 per cent but lower than 100 per cent, that is, foreign firms with majority foreign ownership. Finally, our last category comprises those fully (i.e., 100 percent) acquired firms.

Table 1 gives the frequency distribution of foreign acquired firms in the sample by type of foreign acquisition and year. We ascertain that 1,509 firms (about 5.5 per cent of our sample of firms) received foreign capital for the first time between 2002 and 2006. Wholly owned foreign subsidiaries made up 34 per cent of total acquired firms during the observation period, foreign subsidiaries with majority foreign control accounted for 23 per cent, joint ventures with minority foreign participation represented 33 per cent and local firms that attracted low levels of foreign capital accounted for the remaining 10 per cent.

For the acquired firms, our dataset also allows us to distinguish the origin of the foreign investor. In this paper we distinguish between two types of investors: those Chinese companies investing from Taiwan, Hong Kong and Macao (which we refer as ethic Chinese investors) and those multinational firms investing from the rest of the world (which we regard as foreign MNEs). Our dataset also allows us to identity the type of local partnership, namely private versus state-owned local partners.

Table 1 also shows the distribution of acquired firms according to these characteristics[3]. The sample is fairly balanced between takeovers by ethnic Chinese investors and MNEs from other countries across most of foreign ownership categories. By contrast, foreign acquisitions with state-owned entities as local partners are more common amongst takeovers with higher foreign participation (while 43 percent of small minority foreign acquired firms involve state-owned entities as local partners, this fraction increases to 52 and 66 percent amongst minority and majority acquisitions, respectively).

[Table 1 here]

[3] The raw data also show that the foreign acquisitions exhibit considerable diversification across different industries. Detail is available upon request.

Table 2 gives precise definitions of the main variables used in the analysis. These consist of the treatment variables (type of foreign acquisitions), the outcome variables (R&D and exporting market entry) and the pre-acquisition characteristics which are hypothesised to affect the likelihood of acquisition as will be discussed in the next section.

[Table 2 here]

Figure 1 depicts the proportion of exporting and R&D firms by foreign ownership structure (relative to domestic firms) in the year of acquisition and a year later. This preliminary graphical analysis shows a substantial gap between the proportion of domestic and foreign export firms. The gap is roughly proportional to the share of foreign capital, and increasing over time. By contrast, apart for small minority foreign firms, the differential between the proportion of domestic and foreign R&D firms is not that large and it decrease with the share of foreign capital. This preliminary description suggests that acquired firms with higher levels of foreign ownership are more likely to experience larger export benefits. In contrasts, technological improvements seem to be more likely to occur amongst acquired firms with lower foreign control.

Commented [SL2]: SG, I think we should give some numbers here to help the reader to understand better. Can we say that for example in the case of small minority foreign acquisitions the proportion of new foreign exporters was only about 0.09 (?) percentage points higher than new domestic exporters in the acquisition year and that this differential increased to 0.32 (?) one year after acquisition?

Commented [AA3]: NO I don't think we need this as Figure 1 is self-explanatory, and we have already said that the gap is roughly proportional to the share of foreign capital, and increasing over time.

Table 3 provides summary statistics of pre-acquisition characteristics by type of acquisition. Simple t-tests of equality of means reveal that future recipients of foreign capital were younger, larger, more productive, less leveraged, and paid higher wages compared to firms that remained domestically-owned[4].

[Table 3e]

Overall, these descriptive statistics points out the necessity of adjusting for differences in observable characteristics in the treated and control groups in order to accurately identify our post-acquisition effects.

[4]Full detail of the t-tests is omitted in the interest of saving space. Results are available upon request.

4. Empirical methodology

Recall that the chief research question is whether a hitherto non-exporting and non-R&D firm is more likely to become an exporter and upgrade its technological capacity by undertaking R&D when it receives foreign capital. A second question is whether the degree of foreign ownership plays a role in stimulating these changes. Thus the main parameter of interest is the average treatment or causal effect of foreign acquisitions on the *probability* of exporting and engage in R&D for the first time. The outcome variable of interest is therefore the *change* in exporting and R&D status between the pre and post-acquisition periods, akin to using difference-in-differences strategy.

a. Basic set up

Commented [SL4]: SG, I changed the order of some paragraphs in this section and deleted some bits as there were some repetitions. Could you please check that the changes make sense?

Commented [AA5]: fine

As discussed in Section 3, we define one domestic ownership and four foreign ownership structures, which we denote as s=1,…,4, where: (1) s=1 if the foreign ownership share is less than 25 percent, (2) s=2 if the share of foreign ownership ranges from 25 to 49 percent, (3) s=3 if the share of foreign capital is between 50 and 99 percent, and (4) s=4 if the firm is fully acquired (100 percent) by the foreign investor. In the presence of multiple treatments, the researcher can in theory consider any pairwise combination of the categories and estimate the desired treatment effects (e.g. Lechner, 2002). Consistent with the objective of this paper, we set domestic ownership as the control group (s=0) to construct the counterfactual outcome had newly foreign-owned firms remained in domestic hands. However, by way of further analysis, we will also report results from setting wholly foreign owned firms as the counterfactual group.

We define our foreign ownership treatment variable F_{it}^{s} (for each s=1,…,4) equal 1 if firm *i* that has been in domestic hands up to year *t-1*, is acquired at time *t* under the foreign ownership category *s*; and 0 if it still remains domestically owned. Let $Y_{it+\tau}^{s}$ be the potential *outcome* under foreign ownership category *s* at time $t+\tau$, $\tau \geq 0$. Also denote by $Y_{it+\tau}^{0}$ the potential outcome had

the firm not received any foreign capital. For each firm, only one outcome is observed, the remaining four outcomes are *counterfactuals*. As mentioned before, in our empirical analysis these outcomes refer to probability of observing a *change* in the firm's R&D/exporting status between time *t* and t+τ. We evaluate the post-investment effects on the year of acquisition and two subsequent periods.

Commented [AA6]: ok

To evaluate the average treatment effects of *type-s* foreign ownership, we need to estimate the difference between the mean outcome of all firms receiving foreign capital under foreign ownership *s*, and the mean outcome of the *same* group of firms had they not become foreign subsidiaries:

$$\theta_{t+\tau}^{s} = E[Y_{it+\tau}^{s} - Y_{it+\tau}^{0}] \quad [1]$$

The fundamental problem of causal inference is that the quantity $Y_{it+\tau}^{0}$ is unobservable. That is, we cannot observe the technology and exporting status of foreign acquired firms had they not received FDI. Taking the mean outcome of all domestic firms as an approximation is inappropriate because it is most likely that firms' characteristics that determine the equity position of the foreign investor also determine their future performance.

In the microeconometric evaluation literature, selection on observables refers to the fact that the treatment and control group differ with respect to some measurable characteristics or confounders. Thus selection on observable makes a simple comparison of post-treatment outcomes of the two groups problematic. Two popular estimation strategies used to go round this problem are: (1) covariates/confounders adjusted regression where both the treatment and a saturated function of the confounders are included, and (2) variants of propensity-score matching, including inverse propensity score reweighing where subjects with higher ex ante probabilities are

given less weight to control for selection bias[5]. As far as the former strategy is concerned, unbiased identification requires that the researcher specifies the regression equation correctly. On the other hand, an identification concern with inverse probability weighting is that all relevant confounders might not be included in the model used to estimate propensity score.

In this paper we identify the causal effects using the so-called doubly-robust estimator due to (Bang and Robins, 2005; Emsley et al, 2008)[6]. This estimator combines the propensity score reweighing estimator due to Hirano et al. (2003)[7] with covariates adjustment regression, including a flexible translog function of the covariates in the regression (also known as a saturated function). The doubly robust estimator derives its name from the fact that it provides two opportunities to adjust for selection on observables by combining inverse probability reweighting with regression covariates adjustment. The main advantage of doubly-robust estimators of causal effects is that by combining covariates adjusted regression with inverse probability weighting it offers the possibility of unbiased inference even under model misspecification as long as either the conditional mean regression or the propensity score models are correctly specified.

An additional complication in our set up is the fact that the outcome variables are discrete and jointly determined, suggesting that a simple linear probability model is unlikely to be, at least in

[5] Some examples of the application of these methods in the international trade literature include Arnold and Javorcik (2009), Girma and Görg (2007), Görg et al. (2008) and Guadalupe et al. (2012).

[6] Also see Stata treatment-effects Reference manual: Release 13, which can be accessed at http://www.stata.com/manuals13/te.pdf

[7] Busso et.al (2009) show that propensity score reweighting estimators typically outperform propensity score matching estimators. It is worth noting that, strictly speaking, standard matching estimators wouldn't be appropriate in this setting because of nonlinearity in the outcome variables.

theory, an adequate empirical tool. To deal with these features, we model the R&D and exporting decision jointly using inverse propensity score reweighted bivariate probit regressions which also include a saturated (translog) function of a host of pre-treatment characteristics. As mentioned before, this estimator is consistent when the parametric model for either the propensity score (an ordered logit model of foreign ownership structure in our case) or the regression function (bivariate probit in our case) is correctly specified.

b. Doubly-robust regression

We consider a series of covariance adjusted propensity-score re-weighted bivariate probit regressions of the joint decision to export and engage in R&D of the following general form:

$$Prob(RD_{it+\tau} = 1) = \phi_1[\beta_1 + \alpha_1 F_{it}^s + g(X_{it-1}) + \varepsilon_{it+\tau}] \quad [2a]$$

$$Prob(EXP_{it+\tau} = 1) = \phi_2[\beta_2 + \alpha_2 F_{it}^s + g(X_{it-1}) + u_{it+\tau}] \quad [2b]$$

$$(\varepsilon, u) \sim Bivariate\ Normal\left[\binom{0}{0}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix}\right] \quad [2c]$$

for $s = 1, 2, 3$ and 4, and with error correlation parameter ρ.

In the above equation $RD_{it+\tau}$ ($EXP_{it+\tau}$) is set to 1 if there is a change in the firm's R&D (exporting) status between t-1 (pre-acquisition period) and $t+\tau$, and to 0 otherwise; $g(.)$ is the translog function which consists of the second order polynomial of the vector of pre-treatment covariates ($\boldsymbol{X}$) and their full interactions (i.e. the saturated function).

Because we are interested in average treatment effects (ATE) of foreign acquisition, the doubly robust estimator would require weighting treatment observations by $\frac{1}{p^s}$ and the counterfactual observations by $\frac{1}{1-p^s}$, where p^s is the conditional probability of being acquired under type-s foreign ownership structure relative to remaining in domestic hands.

Commented [SL7]: SG,Can we get rid of the subscript 0 and simply write b1 and b2? I do not think there is a need for that...

Commented [SL8]: SG, I think we should mention in the text what ρ means. The correlation of the residuals from the two models?

Commented [AA9]: Of course standard notaion.

Since we are estimating a nonlinear probability model, neither α_1 nor α_2 in the above model is equivalent to the average treatment effects of foreign acquisitions on the probability of R&D and exporting respectively[8]. To recover average treatment effects from bivariate probit estimates we need to perform further computations. We discuss the steps involved in these computations using the estimation of the average treatment effects of foreign acquisition on the probability of export markets entry as an example.

(i) First, we estimate the determinants of foreign acquisition using an ordered logistic regression and from this we generate the relevant propensity-score p^s (see next sub-section for more detail on the propensity score estimation).

(ii) Second, we estimate the propensity score-weighted bivariate probit regressions (equations 2a-2c) with treated firms getting weight of $\frac{1}{p^s}$ and non-treated firms getting weight of $\frac{1}{1-p^s}$.

(iii) Based on the bivariate probit model estimates, we predict the *potential* probability of exporting under each treatment, $\hat{Y}_{it}^s$ (i.e. setting $F_{it}^s = 1$ for all observations, i=1, …N) and the same probability under the counterfactual case of no acquisition $\hat{Y}_{it}^0$ (i.e. setting $F_{it}^s = 0$ for all observations) :

$$\hat{Y}_{it}^s = \phi_2\left[\hat{\beta}_2 + \hat{\alpha}_2 + \hat{g}(X_{it-1})\right] \text{ and } \hat{Y}_{it}^0 = \phi_2\left[\hat{\beta}_2 + \hat{g}(X_{it-1})\right] \quad [3]$$

Commented [SL10]: SG, should be s, right? sure

(iv) Finally, we calculate the average treatment effect of acquisition on the probability of exporting as the average difference between the two potential outcomes:

$$\text{ATE} = \frac{1}{N}\sum_{i=1}^{N}\left(\hat{Y}_{it}^s - \hat{Y}_{it}^0\right) \quad [4]$$

with standard errors made robust to industry and region clustering.

c. Estimation of the propensity score

[8] For a discussion of how to estimate marginal treatment effects from bivariate probit regressions, see Nichols, A (2011), "Causal inference for binary regression" available http://fmwww.bc.edu/repec/chic2011/chi11_nichols.pdf.

We start by estimating an ordered logit model of foreign ownership structure based on the four categories of foreign ownership ($s=1,...,4$) and setting domestic ownership ($s=0$) as the base group. We follow Lechner (2002) and predict the corresponding probabilities (omitting firm and time indices) π^s, s=0, …,4; and compute our propensity score relative to the base category as:

$$p^s = \frac{\pi^s}{\pi^s + \pi^0} \quad [5]$$

Commented [SL11]: SG, shall we mention that we follow Lechner (2002), who provides a guidance to estimate the ps in a multi-treatment setting?

Commented [AA12]: Ok

We model the probability of following into each of the foreign ownership categories using an ordered logit specification conditional on $g(X)$, where X is a vector of pre-acquisition covariates that are hypothesised to impact on the choice of foreign ownership structure, and g represents the translog function. In our empirical implementation, the vector of covariates X consists of firm size, age, wages productivity, SOE status and access to finance (leverage) and the full set of industry and time dummies[9]. The choice of these covariates is guided by the existing literature on the determinants of foreign acquisition [e.g. Harris and Robinson (2002); Conyon et al. (2002 and Girma and Görg (2007)]. Note that the inclusion of leverage in the vector of covariates is motivated by the argument that Chinese firms with limited access to domestic finance are likely to be foreign takeover targets (Huang, 2005). However it is worth remembering that as in all propensity score based methods, the ultimate choice of covariates rests on the success of the ensuing balancing tests.

The marginal effects from the ordered logit model of the determinants of the foreign ownership structure are reported in Appendix A.[10] The sign and significance of the estimated coefficients are similar for all four types of ownership share. Our results are consistent with a large body of empirical work showing that foreign firms have strong preferences for the best performing firms ("cherry picking"). Thus, we find that younger, larger, more productive and higher waged (a

[9] The definition of these variables and their summary statistics are presented in Table 3.
[10] The estimated raw coefficients, including the interaction terms between the covariates, are available from the authors upon request.

possible proxy for skill composition) firms are more likely to be acquired by foreign investors. By contrast multinational firms are less inclined to buy into state-owned or highly leveraged firms.

d. Common support and balancing conditions

An important requirement to identifying causal treatment effects is the common support or overlap condition where the probability of being acquired under category s conditional on X is bounded away from zero and one. We thus impose the common support condition to ensure that any combination of characteristics observed in the foreign acquired firms can also be replicated amongst domestic firms.

Commented [AA13]: Ok, good.

In addition, to ensure that the propensity score is successful in controlling for firm differences in the pre-acquisition period we carry out a series of balancing test. To this end, for each control group and type-*s* acquired firms pairing, we divide the sample by propensity score quintile, and for each subsample we test for equality in means of the pre-treatment covariates between acquired and non-acquired firms. For the six covariates in X and the four acquisition types, this involves conducting equality of means tests in each of the five quintiles. In Appendix B, we report the results from these 120 balancing tests. It is indeed reassuring that these tests emphatically demonstrate that the balancing conditions are satisfied.

5. Main findings and discussion

5.1 Estimates from the baseline model

Having established that conditional on the propensity score, acquired and non-acquired firms are comparable, we now present in Table 4 the doubly-robust logistic regression estimates of the causal effects of foreign acquisitions on the probability of R&D "take-off" and export market entry. We show the effects in the year of acquisition, and within one year and two years of acquisition.

We begin by noting that during the year of acquisition, the effects of the foreign acquisition on the probability to engage in R&D are either statistically or economically insignificant for all types of ownership structure. However a clearer pattern starts to emerge within one year of acquisition. Minority and small minority foreign ownership structures appear to be conducive to R&D take-off. For example minority foreign acquired firms are 7.4 percent more likely to undertake R&D than otherwise comparable firms that remained in domestic hands. By contrast wholly owned foreign firms are 2.7 percent less likely to receive R&D investment compared to their domestically owned peers. Although we have no direct evidence, we speculate that this pattern is consistent with the notion that the technology gap between the foreign acquirer and domestic target may play a role. The foreign acquirer may be engaging in joint ventures with local partners in firms where the level of technology is below the level of the acquirer. Hence, there is a strong potential for technology upgrading post-acquisition. For targets that are 100 percent taken over the technology gap between foreign acquirer and target may be *relatively* low, thus not necessitating strong efforts in technology upgrading. For small minority foreign acquired firms, these positive effects on R&D activity get quite stronger within two years of acquisition, though we have to caution that the longer the post-acquisition time horizon, the more difficult it might be to isolate the pure effects due to acquisition.

In contrast to R&D, the FDI-induced causal effects on export markets entry are consistently positive and persistent across all ownership categories. For example, wholly acquired firms are 17 percent more likely to start exporting within a year of acquisition than domestic firms. This effect is even more impressive at 20.2 percent for minority acquired firms[11].

[Table 4 here]

[11] A simple t-test of based on the reported standard errors rejects the null hypothesis of equality of means.

5.2 Sensitivity analysis

Table 5 reports the causal effect estimates of foreign acquisitions on R&D and exports from a series of specifications designed to check the sensitivity of our baseline model. All reported results are based on outcomes within a year of acquisition. As mentioned before, focusing on a short time horizon allows us to capture better the pure effects due to acquisition.

The first block of Table 5 gives estimates from covariate adjusted bivariate probit regressions without propensity score reweighting. This approach should deliver consistent estimators as long as the conditional mean model is correctly specified[12]. Overall we reach similar conclusions to the ones based on estimates from the doubly-robust models. Thus foreign takeover unambiguously boosts export performance in the acquired target, and its positive impact on R&D is confined to non-majority acquisitions. However it would appear that unweighted regressions overestimate the beneficial effects of foreign ownership on exporting, especially for majority and whole acquisitions. This is perhaps not too surprising given that probability reweighing corrects for selection effects by assigning less weight to firms with higher propensity to be acquired, and hence to export in the future.

Notwithstanding the fact that linear propensity score matching approach is not theoretically appropriate for non-linear models, we check the sensitivity of our results to the choice of the estimator by employing a linear probability modelling framework where the decision to export and engage in R&D are jointly estimated using a seemingly unrelated regressions(SURE) framework. The results from this experiment are shown in the second block of Table 5. It is reassuring to see that our conclusion that all types of foreign acquisitions are conducive to export markets entry

[12] Indeed using some simulation studies, Freedman and Berk (2008) conclude that "if investigators have a good causal model, (emphasise our own) it seems better just to fit the model without weights".

remains intact. We also confirm the beneficial effects of foreign acquisitions on R&D are confined to minority and small minority joint ventures.

Are the results driven by export processing firms?

A legitimate question at this juncture is whether the positive causal effects of foreign acquisitions on exporting is driven by the possibility that MNEs might have used some of these firms to process imported intermediate inputs for exports. If this is indeed the case, our finding that FDI promotes exports market entry would have looked less impressive. We address this issue by re-estimating our models without acquired firms that are chiefly used for processing intermediate inputs. We did so by first matching our firm level data with the transaction level data obtained from the Chinese Customs Trade Statistics (see Manova and Yu, 2014). We managed to match a third of the *exporting* firms in our database to the customs dataset. This allows us to identify a significant proportion of firms that are engaged in processing trade, 246 of which are in the sub-sample of the database used for this analysis. This low number can be explained by our research design which ruled out all firms with positive exports and foreign capital prior to investment liberalisation, precisely the type of firms that tend to have a high propensity to engage in export processing. For the purpose of our sensitivity analysis, we classify a firm as engaging in mainly export processing if processing exports account for more than a half of total exports (processing exports + "ordinary" exports).

Commented [SL14]: SG, I guess you use the bi-Probit reweighted regression again here, right? if so, shall we mention it in a footnote and also add a note in Table 5?

Commented [AA15]: Ok.

The results from this exercise are reported in the third block of Table 5. The effects on R&D are largely as reported in Table 4. Also reassuringly we confirm that our findings of significant exporting effects due to foreign acquisitions are nor driven by the presence of major export processing firms.

Whole acquisition as the counterfactual

Recall that in our baseline treatment effects model we set the counterfactual as being domestically owned, and we have found economically significant differentials in terms of the effects of foreign

ownership on exporting and R&D. Our aim here is to check whether these differentials would persist under a different experimental setting. Accordingly, the last two columns of Table 5 give the average treatment effects of being partially foreign acquired compared to the counterfactual of being wholly acquired. Consistent with the findings from our baseline model, we uncover evidence that non-wholly acquired firms have higher probabilities of undertaking R&D than would have been the case were they under 100 percent foreign ownership. We also find that the probability of export market entry is lower compared to the counterfactual scenario of 100 percent foreign ownership.

[Table 5 here]

5.3 Is the source of FDI important?

Next, we explore whether the effects of the foreign ownership structure is dependent on the geographic origin of FDI. For instance the technology gaps between the acquirer and the target might vary with the origin of the foreign investor, and this might have discernible post-acquisition implications. Our dataset allows us to distinguish between foreign acquirers of Chinese origin or "ethnic Chinese" (which account for nearly 53 percent of total acquirers) and foreign investors from the "rest of the world" (mainly from OECD countries).

The results from this exercise (also based on the outcomes within a year of acquisition) are reported in Table 6. In line with our baseline results presented in Table 4, we show that both types of investors appear to contribute to the R&D take-off of small minority and minority acquired firms, and that neither source of FDI appear to increase the likelihood of R&D investment by wholly acquired firms. Interestingly, we uncover significant positive R&D effects on majority acquired firms by foreign MNE investors, while the negative effect are confined to those firms that are acquired by ethnic Chinese investors. As far as the magnitude of the export market entry effects are concerned, these are much stronger for foreign MNE in all but the case of full acquisitions.

Commented [SL16]: shall we speculate a bit why this happens? Perhaps because foreign MNEs are better connected to global networks?

Commented [AA17]: May be not. We don't want referees to come back to use saying where is your proof ☺

[Table 6 about here]

5.4 Does the type of local partner matter?

We also investigate whether the post-acquisition effects depend on the ownership status of the local partner, i.e., whether it is private or state-owned (SOE).[13] There are two conflicting views on choosing SOE as local partners. One view argues that the performance of state owned firms remains unsatisfactory (e.g. Lin et al, 1998, Xu and Wang, 1999) due to the historical social legacy, for example, maintaining low levels of unemployment which often meant keeping unskilled labour. On the other hand, state partnership might have a positive impact on performance because such foreign firms are politically well-connected and have better opportunities to receive government subsidies (Sun et al., 2002).

As we report in Table 6, our analysis leads to the conclusion that the role of local partners on R&D appear to vary across ownership categories. Again, in line with our baseline results presented in Table 4, we find that FDI contributes to the R&D take-off of small minority and minority acquired firms regardless of whether the local partner is private or state-owned. A noteworthy result from this analysis is that majority foreign owned firms with private local partners are significantly more likely to engage in R&D, whereas majority foreign owned firms with state-owned local partners continue to experience lower likelihood of R&D investments. Regarding the export activity, our results confirm that there is a strong evidence of positive export market entry effects for all types of foreign acquisitions regardless of the local partner. Interestingly, there is a stronger evidence to suggest that hitherto non-exporting state-owned firms enjoy a higher likelihood of entering international markets as a result of minority acquisitions by multinational firms.

Commented [SL18]: Again, I think we should try to give an explanation of why these export effects appear to be stronger amongst small minority and minority acquired firms with SOEs as local partners. I can't think of anything at the moment. Any views? I will continue thinking...

Commented [AA19]: Keep thinking until deadline day ☺

[13] Since we now only consider partnerships with local firms we, by definition, exclude wholly owned affiliates as this does not involve a local partner.

5.5 Further analysis

In our baseline model, we abstracted from the various well-documented econometric issues plaguing the estimation of TFP, and concentrate rather on value added per worker (which in any case is found to be highly correlated with TFP in most countries' micro data). However, to check our results further, in the first block of Table 7 we report the causal effects within one year of acquisition using TFP estimated following Levinsohn and Petrin (2003). These results are reassuringly similar to the ones reported in Table 4.

Accounting for possible spillovers

The average treatment effects estimation framework we employed is underpinned by the fundamental assumption of the absence of significant spillovers from foreign to domestic firms, and indeed between foreign firms themselves[14]. This assumption is known as the stable-unit-treatment-value assumption (SUTVA). It is of course quite possible that SUTVA does not hold in the data. In this case, (i) export and R&D spillovers from foreign to domestic firms may occur (e.g. Mayneris and Poncet, 2013), and (ii) the average impact of foreign acquisition may depend on the proportion of acquired firms within an industry or region (e.g. agglomeration effects).

As far as foreign to domestic spillovers are concerned, we argue that this concern is greatly mitigated by the very nature of our experimental setting, namely the fact that we started with firms with no previous R&D and exporting experience. The scope for newly exporting or R&D investing foreign firms to transfer their knowledge to domestic firms is arguably limited, at least in the short post-acquisition period we are focusing on.

[14] We thank an anonymous referee for encouraging us to discuss this issue, and for generously suggesting some ideas.

In order to ascertain that our results are not affected by foreign to foreign cross-effects, we exploit the industrial and spatial dimensions in our data and control for the proportion of foreign acquired firms in the region and industry when calculating the average treatment effects given in Equation (4). The results from this exercise are reported in the second block of Table 7, and the pattern and magnitude of the effects are largely similar to those found earlier. However this exercise also highlights the existence of potentially interesting exports agglomeration effects associated with non-minority foreign acquisitions.

Exploring the sequence of R&D investment and exporting

Do firms first engage in R&D or exporting? And what is the role of acquisition FDI in influencing the timing of this sequence? For the sake of brevity we do not fully explore the issue in the paper, as we think it is topic which merits to be analysed in its own right and perhaps with more detailed considerations. Nonetheless in the last two columns of Table 7 we report results from doubly robust regressions of the impact of FDI on the probabilities to engage in R&D first and exporting first. For the purpose of this experiment we define exporting (investing in R&D) first if firm exports (invest in R&D) for the first time anytime between t and $t+2$, where t is the period of acquisition. All other combinations are treated as the base group. The results suggest that acquisition FDI increases the likelihood of exporting first across the ownership structure spectrum.

Commented [SL20]: are they these estimations based on simple probit models?

Commented [AA21]: Bivaraite probit, unless otherwise stated.

Commented [SL22]: shouln't be written as the probability to engage in R&D (exporting) first?

Commented [AA23]: No it is fine as it is.

Commented [SL24]: the opposite happens to R&D (of course). I have a silly question: aren't we selling the idea that exporting and R&D happen simultaneously? isn't this the rationality for estimating bivariate probit models? Sorry, I may be messing things up.

Commented [AA25]: As stated in the text, all other combinations are treated as the base group, so this exercise does not rule out that exporting and R&D happen simultaneously.

6. Conclusions

In the run up to its accession to the WTO in 2001, China has undergone far-reaching investment liberalisation. In this paper we exploit the fact that as part of this investment liberalisation process, existing restrictions on foreign ownership structure and mandatory export and technology transfer requirements imposed on foreign firms had been lifted in a number of industries, to identify the causal effects of foreign acquisitions on export markets entry and technology take-off. Using doubly robust propensity score reweighted bivariate probit regressions to control for selection bias associated with foreign acquisition incidences, we uncover strong but heterogeneous positive

effects on export activity for all types of foreign ownership structure. We also find that minority foreign owned acquisition targets experience higher likelihood of R&D.

From policy makers' perspectives, our results provide solid evidence that joint ventures between foreign owners and Chinese firms can contribute positively to China's "science and technology take-off". From an academic point of view, our work should inform future theoretical contributions as we have documented much needed econometric evidence that foreign ownership structure matters for exporting and R&D decisions, and it is therefore an important source of firm heterogeneity.

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Commented [SL26]: I have NOT checked the references yet.

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Figure 1: Foreign ownership structure and the proportion of export and R&D firms: Differentials in relation to domestic firms with 95% confidence intervals

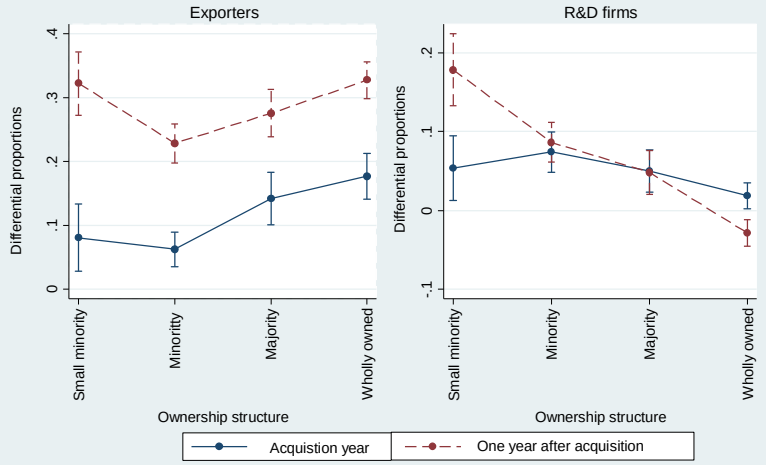

Table 1
Frequency distribution of sample firms by type of foreign acquisition

	By type	By type and local partners		By type and source of FDI		By type and year				
		Private	State	Foreign	Ethnic Chinese	2002	2003	2004	2005	2006
Small minority acquisition	152	86	66	79	73	25	12	29	32	54
Minority acquisition	497	240	257	245	252	89	53	96	112	147
Majority acquisition	349	118	231	174	175	69	54	67	66	93
Wholly acquired	511	n.a	n.a	213	298	84	43	147	79	158
Total	1509	444	554	711	798	267	162	339	289	452

Note: The number of non-acquired domestic firms in the sample is 26004.

Table 2
Definition of the main variables used in the analysis

Variable	Definition
Size	Log of total employment
Productivity	Log of real value added per worker
Wages	Log of real wages per worker
Leverage	Total liability/total assets.
Age	Log of firm age since incorporation
State Owned Enterprise (SOEs)	Dummy variable equal to 1 if the State holds shares in the firm's capital, 0 otherwise
Research and Development	Change Dummy variable equal to 1 if the firm starts investing in R&D, and 0 otherwise
Exports	Change Dummy variable equal to 1 if the firm starts exporting, and 0 otherwise
Treatment variables (in all cases with no prior exporting or R&D experience)	
Small minority acquisition	The share of the firm's total capital owned by foreign acquirer is positive but less than 25.
Minority acquisition	The share of the firm's total capital owned by foreign acquirers is greater than or equal to 25 percent but less than 50 percent.
Majority acquisition	The share of the firm's total capital owned by foreign acquirers is greater than or equal to 50 percent but less than 100 percent.
Wholly acquired	The share of the firm's total capital owned by foreign acquirers is equal to 100 percent.

Table 3
Summary statistics of pre-acquisition characteristics by type of acquisition

	Size	Productivity	Wages	Age	Leverage	SOE
Non-acquired						
Mean	4.626	3.846	6.928	2.065	2.547	0.0680
Median	4.564	3.786	6.852	2.079	1.623	0
St. deviation	0.907	1.150	0.985	0.940	2.536	0.252
Observations	26004	26004	26004	26004	26004	26004
Small minority acquisition						
Mean	5.214	4.027	7.610	1.906	2.524	0.0526
Median	5.127	3.939	7.530	1.946	1.502	0
St. deviation	1.189	1.263	1.293	0.965	2.573	0.224
Observations	152	152	152	152	152	152
Minority acquisition						
Mean	4.822	4.012	7.265	1.748	2.734	0.0423
Median	4.718	3.928	7.185	1.792	1.651	0
St. deviation	0.967	1.032	1.065	0.866	2.701	0.201
Observations	497	497	497	497	497	497
Majority acquisition						
Mean	4.895	3.966	7.315	1.560	2.434	0.0430
Median	4.828	3.803	7.288	1.609	1.491	0
St. deviation	0.959	1.220	1.156	0.850	2.534	0.203
Observations	349	349	349	349	349	349
Whole acquisition						
Mean	4.792	3.847	7.152	1.437	2.209	0.0294
Median	4.762	3.835	7.074	1.386	1.238	0
St. deviation	0.969	1.097	1.066	0.863	2.460	0.169
Observations	511	511	511	511	511	511
Overall						
Mean	4.639	3.851	6.947	2.040	2.542	0.0664
Median	4.575	3.790	6.873	2.079	1.613	0
St. deviation	0.914	1.149	0.995	0.943	2.538	0.249
Observations	27513	27513	27513	27513	27513	27513

Table 4:
Average treatment effects from propensity-score weighted Double robust regressions

	Year of acquisition		Within one year of acquisition		Within two years of Acquisition	
Acquisition type	**R&D**	**Export**	**R&D**	**Export**	**R&D**	**Export**
Small minority	-0.011***	0.113***	0.074***	0.106***	0.289***	0.138***
	(0.0003)	(0.0023)	(0.0017)	(0.0015)	(0.0049)	(0.0018)
Observations	24907	24907	24816	24816	24728	24728
Minority	0.014***	0.076***	0.049***	0.202***	0.036***	0.185***
	(0.0004)	(0.0016)	(0.0006)	(0.0041)	(0.0004)	(0.0028)
Observations	25666	25666	25570	25570	25391	25391
Majority	0.004***	0.037***	-0.003***	0.062***	0.015***	0.074***
	(0.0001)	(0.0007)	(0.0000)	(0.0010)	(0.0001)	(0.0008)
Observations	25902	25902	25801	25801	25666	25666
Whole	-0.007***	0.084***	-0.027***	0.170***	-0.034***	0.161***
	(0.0002)	(0.0018)	(0.0006)	(0.0018)	(0.0005)	(0.0017)
Observations	22980	22980	22889	22889	22746	22746

Notes:

(i) Fully saturated of the pre-acquisition characteristic and industry-time dummy are included in the regression.

(ii) The counterfactual is being domestically owned.

(iii) Robust standard errors are given in parentheses.

(iv) $^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

Commented [SL27]: SG: shouln't we report the value and significance of ? Also, I have a silly question: if the decision to export and invest in R&D are jointly determined, does it still make sense to talk about the timing of exporting and R&D, as in section 5.5?

Commented [AA28]: No need to report roughly 50 coefficients for each coluum!!. It is usually a job for online publication only, and nobody asked us!! Even then they would have been totally uninformative.

Commented [AA29]: Just because we model the probability of joint determination, does not means we can't also model other probabilities. Note that we did not STATE that R&D and exports are always go together. In fact from Pr(RD=1, EXp=1) is just one option of bivariate probit (the default one), but you can calculate
Pr(RD=1, EXp=0); Pr(EXP=1|RD=1), or just Pr(RD=0). Check the postestimation command of biprobit!

Table 5:
Sensitivity analysis

	Covariate adjusted only without reweighing		Linear probability model		Excluding major exports processing firms		Wholly acquired vs. partially acquired firms	
Acquisition type	**R&D**	**Export**	**R&D**	**Export**	**R&D**	**Export**	**R&D**	**Export**
Small minority	0.044***	0.131***	0.069***	0.135***	0.074***	0.106***	0.049***	-0.099***
	(0.0005)	(0.0012)	(0.024)	(0.027)	(0.002)	(0.001)	(0.003)	(0.002)
Observations	24816	24816	24816	24816	24800	24800	657	657
Minority	0.054***	0.139***	0.070***	0.141***	0.049***	0.203***	0.088***	-0.095***
	(0.0005)	(0.0013)	(0.013)	(0.015)	(0.001)	(0.004)	(0.002)	(0.001)
Observations	25570	25570	25570	25570	25553	25553	998	998
Majority	-0.008***	0.188***	-0.010	0.202***	-0.002***	0.062***	0.015***	-0.034***
	(0.0001)	(0.0016)	(0.015)	(0.017)	(0.000)	(0.001)	(0.000)	(0.000)
Observations	25801	25801	25801	25801	25777	25777	846	846
Whole	-0.010***	0.276***	-0.011	0.288***	-0.028***	0.161***	*n.a*	*n.a*
	(0.0001)	(0.0019)	(0.013)	(0.015)	(0.001)	(0.002)		
Observations	22889	22889	22889	22889	22852	22852		

Notes:

(i) All results based on outcome within one year of acquisition.

(ii) Fully saturated of the pre-acquisition characteristic and industry-time dummy are included in the regressions.

(iii) Results in the last four columns are based on doubly robust propensity score reweighted bivariate probit estimation.

(iv) The last two columns give average treatment effects of being partially foreign acquired compared to counterfactual being wholly acquired. In all other cases, the counterfactual is being domestically owned.

(v) Robust standard errors are given in parentheses.

(vi) $^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.$

Commented [SL30]: SG, should we mention the estimator used in the last 4 columns. Doubly robust propensity score reweighted bivariate probit?

Commented [AA31]: done

Table 6:
The role of local partnership and source of FDI

	Ethnic Chinese vs. Foreign MNE acquisitions				Private vs. State-owned local partners			
	R&D		**Exporting**		**R&D**		**Exporting**	
Acquisition type	Ethnic Chinese	Foreign	Ethnic Chinese	Foreign	Private	State	Private	State
Small minority	0.040***	0.097***	-0.038***	0.228***	0.043***	0.107***	0.024***	0.203***
	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)	(0.002)	(0.000)	(0.002)
Observations	24816	24816	24816	24816	24816	24816	24816	24816
Minority	0.074***	0.030***	0.172***	0.228***	0.095***	0.006***	0.164***	0.251***
	(0.001)	(0.000)	(0.004)	(0.004)	(0.001)	(0.000)	(0.004)	(0.005)
Observations	25570	25570	25570	25570	25570	25570	25570	25570
Majority	-0.008***	0.006***	0.033***	0.102***	0.007***	-0.008***	0.089***	0.047***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
Observations	25801	25801	25801	25801	25801	25801	25801	25801
Whole	-0.017***	-0.041***	0.176***	0.166***	*n.a*	*n.a*	*n.a*	*n.a*
	(0.000)	(0.001)	(0.002)	(0.002)				
Observations	22889	22889	22889	22889				

Notes:

(i) All results based on outcome within one year of acquisition.
(ii) Fully saturated of the pre-acquisition characteristic and industry-time dummy are included in the regression (see Equation 2 in the text for detail).
(iii) The counterfactual is being domestically owned.
(iv) Robust standard errors are given in parentheses.
(v) * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Commented [SL32]: SG, wouldn't be interesting to see the effects on those firms that were previously SOEs and became fully acquired?

Commented [AA33]: These four columns are about local partnership, so it does not make to talk about previous SOEs (or indeed non-SOEs). In general yes it might be interesting to know, but not in this table.

Table 7
Further analysis

	With sales based TFP measure of productivity		With industry-region proportion of acquired firms		Exploring the sequence of R&D and exporting	
Acquisition type	**R&D**	**Exporting**	**R&D**	**Exporting**	**R&D first vs. all other combinations**	**Exports first vs. all other combinations**
Small minority	0.073***	0.110***	0.074***	0.107***	-0.201***	0.071***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
PROP			0.011	-0.024		
			(0.023)	(0.020)		
Observations	24816	24816	24816	24816	24907	24907
Minority	0.067***	0.211***	0.049***	0.200***	-0.210***	0.186***
	(0.001)	(0.004)	(0.001)	(0.005)	(0.003)	(0.003)
PROP			-0.0001	0.046		
			(0.008)	(0.052)		
Observations	25526	25526	25570	25570	25666	25666
Majority	0.004***	0.057***	-0.002***	0.060***	-0.054***	0.046***
	(0.0001)	(0.001)	(0.0001)	(0.001)	(0.001)	(0.001)
PROP			-0.001**	0.046***		
			(0.001)	(0.013)		
Observations	25755	25755	25801	25801	25902	25902
Whole	-0.021***	0.163***	-0.027***	0.166***	-0.141***	0.160***
	(0.0001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)
PROP			-0.013	0.072**		
			(0.008)	(0.029)		
Observations	22849	22849	22889	22889	22980	22980

Notes:

(i) All results are also based on outcome within one year of acquisition.
(ii) PROP refers to the proportion of other foreign acquired firms in a firm's industry-region; a term designed to capture potential spillovers amongst acquired firms.
(iii) Fully saturated of the pre-acquisition characteristic and industry-time dummy are included in the regression
(iv) The control group consists of domestic firms
(v) Standard errors are given in parentheses.
(vi) * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Commented [SL34]: SG: sales?

Commented [AA35]: Sales based, as oppose to value added based measure of TFP we had. One ref seems to think value added measure is not so good in China. Obviously we have to respond to all of their idiosyncratic demands.

Commented [SL36]: SG, should we mention that all results are also based on outcome within one year of acquisition?

Commented [AA37]: done

Appendix A

The determinants of foreign acquisition structure: Average marginal effects from the ordered logit model

	Foreign acquisition type			
	Small minority	**Minority**	**Majority**	**Whole**
Size	0.00008	0.00025	0.00015	0.00009
	(0.00027)	(0.00081)	(0.00052)	(0.00088)
Productivity	0.00091***	0.00274***	0.00173***	0.00277***
	(0.00015)	(0.00042)	(0.00028)	(0.00045)
Wage	0.00129***	0.00389***	0.00246***	0.00417***
	(0.00025)	(0.00073)	(0.00047)	(0.00077)
Age	-0.00241***	-0.00732***	-0.00465***	-0.00765***
	(0.00023)	(0.00050)	(0.00037)	(0.00057)
Leverage	-0.00029***	-0.00087***	-0.00056***	-0.00093***
	(0.00011)	(0.00031)	(0.00020)	(0.00034)
SOE	-0.00141*	-0.00429*	-0.00273*	-0.00449*
	(0.00076)	(0.00230)	(0.00149)	(0.00271)
Observations	27513	27513	27513	27513

Notes:
(i) Industry-year effects are controlled for in all regressions.
(ii) * p<0.1, ** p<0.05, *** p<0.0

Appendix B

Balancing tests for differences in observed pre-treatment characteristics

Domestic versus small minority acquisition firms

Propensity score quintile	SIZE	PROD	WAGE	AGE	LEVERAGE	SOE
1	-0.0531	-0.0822	-0.1278	-0.1076	-0.1351	0.0110
	(0.223)	(0.254)	(0.239)	(0.149)	(0.616)	(0.054)
2	0.1430	-0.3068	0.4372	0.1940	0.3885	-0.0383
	(0.298)	(0.339)	(0.319)	(0.199)	(0.823)	(0.072)
3	0.0568	-0.1134	0.2192	-0.0247	0.3480	0.0642
	(0.294)	(0.335)	(0.315)	(0.197)	(0.812)	(0.071)
4	-0.0399	0.0417	0.0914	0.0613	0.1279	-0.0085
	(0.258)	(0.293)	(0.276)	(0.173)	(0.712)	(0.062)
5	0.0576	0.2084	0.0403	-0.0039	-0.4864	-0.0675
	(0.228)	(0.260)	(0.245)	(0.153)	(0.631)	(0.055)
Observations	24907	24907	24907	24907	24907	24907

(Appendix B continued)

Domestic versus minority acquisition firms

Propensity score quintile	SIZE	PROD	WAGE	AGE	LEVERAGE	SOE
1	-0.1451	-0.0316	-0.0658	0.0281	-1.4013	-0.1117
	(0.383)	(0.427)	(0.409)	(0.259)	(1.097)	(0.115)
2	0.0295	-0.3235	0.1658	-0.2485	0.4773	0.1936
	(0.501)	(0.558)	(0.535)	(0.339)	(1.435)	(0.150)
3	0.5745	-0.2241	0.6728	0.0459	3.1462*	0.0467
	(0.430)	(0.479)	(0.459)	(0.291)	(1.232)	(0.129)
4	0.2327	-0.1157	0.2496	0.1723	1.6445	0.1026
	(0.404)	(0.450)	(0.432)	(0.273)	(1.157)	(0.121)
5	0.1993	0.2154	0.1512	0.0505	1.2851	0.1023
	(0.387)	(0.432)	(0.414)	(0.262)	(1.109)	(0.116)
Observations	25666	25666	25666	25666	25666	25666

Domestic versus majority acquisition firms

Propensity score quintile	SIZE	PROD	WAGE	AGE	LEVERAGE	SOE
1	-0.0512	0.0502	0.0638	-0.0287	0.3245	-0.0796
	(0.215)	(0.238)	(0.229)	(0.143)	(0.607)	(0.060)
2	0.0600	0.0535	0.0557	0.0941	-0.3535	0.1029
	(0.266)	(0.294)	(0.284)	(0.177)	(0.751)	(0.074)
3	0.3922	-0.2916	0.3326	0.2118	-0.1724	0.0741
	(0.272)	(0.301)	(0.291)	(0.181)	(0.770)	(0.076)
4	0.1293	-0.0625	0.0534	0.1884	0.2460	0.0782
	(0.238)	(0.263)	(0.254)	(0.158)	(0.672)	(0.066)
5	0.0405	0.0630	-0.0183	-0.0527	0.2918	0.0973
	(0.222)	(0.245)	(0.237)	(0.147)	(0.626)	(0.062)
Observations	25902	25902	25902	25902	25902	25902

Domestic versus whole firms

Propensity score quintile	SIZE	PROD	WAGE	AGE	LEVERAGE	SOE
1	0.1701	0.1659	0.1723	0.3036	0.4017	0.1368
	(0.384)	(0.427)	(0.412)	(0.255)	(1.086)	(0.101)
2	-0.1829	0.1011	-0.4089	-0.4046	-0.3034	-0.1755
	(0.543)	(0.603)	(0.582)	(0.360)	(1.534)	(0.143)
3	-0.1492	-0.2715	-0.1422	-0.0225	-1.2473	-0.0464
	(0.502)	(0.557)	(0.538)	(0.333)	(1.419)	(0.132)
4	0.0434	0.1442	0.1326	0.0874	-0.6653	-0.1263
	(0.433)	(0.481)	(0.464)	(0.287)	(1.223)	(0.114)
5	0.3044	-0.1407	0.2130	-0.0360	-0.0842	-0.1700
	(0.397)	(0.440)	(0.425)	(0.263)	(1.121)	(0.104)
Observations	22980	22980	22980	22980	22980	22980